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ABSTRACT

This report provides a picture of students who entered a university engineering program and then persisted or left the program. It examines students' mathematical-mechanical abilities, psychological-motivational aspects, support services, and perceptions of the world of engineering work. It also identifies problems that women and blacks encountered. A total of 606 responses were received from a survey mailed to 2,450 Michigan State University engineering students. Students were sorted into the following groups: persisters, changers, leavers, transfers, and first timers. The survey results are presented in terms of: (1) respondents' high school experiences (time of making career decision, factors influencing the decision, and academic preparation); (2) experiences in engineering (typical day, expectations, problems, academic performance, and support services); (3) non-persistence in engineering; (4) stereotyped images of engineers and how these relate to blacks and women; and (5) career plans. Findings showed that students leaving the program had less commitment to engineering and inconclusive career goals compared to persisters. Mathematics was the basic culprit undermining student academic progress. Women felt they were not taken seriously in the classroom, laboratory, and work place. Blacks worked twice as many hours as whites to finance their education, and study time suffered as a result. Includes seven references. (JDD)

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Introduction

Concern over the potential shortage of engineers has been expressed continually throughout the 1980's (e.g. Office of Technology Assessment, 1985). One partial solution to the problem has been to call for the recruitment of new engineers, particularly from the ranks of women and minorities -- two groups that have the potential to fill college classrooms. The number of women engineering students has increased dramatically since 1972 (Jagacinski, et. al, 1987), although a levelling off in enrollments has occurred since 1984. Minority enrollments have not experienced quite the same increase as women.

To support recruitment of new engineers, attention has been given to improving pre-college experiences with regards to the mathematical, mechanical and scientific dimensions required in engineering. Programs to strengthen mathematical skills and provide computer and other technical (mechanical) abilities have been common. While differences exist between gender and racial proficiency, the gaps, in most cases, have been narrowing. Nevertheless, enticing minorities and women into and then retaining them in engineering has remained a challenge.

Potential factors that might influence a student's decision to pursue engineering include psychological and social conditions, in addition to academic issues. What motivates a student to enter and sustain an interest in engineering? Do peer networks support or discourage completion of a degree? How do perceptions of the work-place and receptivity in the field influence an individual's commitment to engineering?

To answer these questions, a picture of the students in engineering needs to be drawn to capture a broader set of dimensions. This report summarizes a study that examined a comprehensive set of factors, including mathematical-mechanical abilities, psychological-motivational aspects, support services (e.g. mentors, family, and institution), and perceptions on the field of engineering and the world of work in engineering.

A general overview of the findings is presented in this report. More detailed and focused examinations are underway and will be presented separately. This report does provide a candid picture of those students who entered engineering over the last few years, tracking those who have persisted as well as those who have left engineering to pursue other majors.

Sample

The Office of Planning and Budgets at Michigan State University provided a list of students that compared engineering enrollments in the fall of 1987 with enrollments in the fall of 1988. From this list, students were sorted into the following groups: (1) Persisters - persisting in engineering, in the same major; (2) Changers - persisting in engineering but changing majors; (3) Leavers - left engineering still at the University. (Students who left engineering and left the University could be identified but were not used in this study.); (4)

Transfers - transferred into engineering (early before the junior year and late after the junior year); and (5) First Timers - new arrivals in their first year of school or still classified as freshmen. Before drawing a random sample, the groups were further stratified according to gender, and then race.

All minorities were sampled. A random weighted sample of White males and females was taken with slightly more males sampled than females. The only group not participating fully in this project was graduating seniors who were involved in another survey research project that was being conducted at approximately the same time.

The survey instrument was pre-tested on a small group (approximately 200) early in the school year. After evaluating the pre-test comments and results, 2,250 students were sent questionnaires. Pretest responses were included in the overall sample for a population of 2,450. Special efforts were made to contact participants by phone as a reminder, particularly if the response rate was low in a certain subgroup.

A total of 606 responses were received (25% return rate). This response rate is conservative as some First Time Arrivers and Leavers (especially those who were freshmen and sophomores) reported that they never intended to be engineering majors but included that major on their orientation form prior to enrolling. By group, response rates fell between 20% and 25% with early transfers only responding at a rate of 13%. By gender, the men's response rate was approximately 21% while the women's was 35%. The response rate for minorities was low, with Black women responding at a 17% rate while Black men responded at a 7% rate. All other minorities, irrespective of sex, responded at a 13%. Minority response patterns presented some problems in the data analyses and subsequent interpretation of results.

Survey Instrument

A questionnaire was designed to tap into perceptions and feelings about engineering at various stages in a student's educational experience. The first section covered high school factors, such as: academic achievement; perception of the individual's ability among his or her peers; people, events or beliefs that may have influenced the decision to study engineering; and the student's perceptions of their father's and mother's careers.

The second section dealt with the attitudes and perceptions of the students while enrolled in engineering. Specific questions examined the problems these students faced; how their time was allocated during the week and on weekends; the comparison of their expectations before they entered the program with the realities of the program; their use of available resources and support services; their friendship networks; and their academic abilities and achievements while in the program.

For those students who left engineering to pursue another major, the third section addressed their reasons for leaving and the selection of a new major. In the fourth section all respondents were asked to discuss their career plans, estimate their starting salary, and

rate the importance of a list of possible career goals. This section also included three questions on (1) the stereotyped engineer; (2) problems for Blacks in engineering; and (3) problems for women in engineering.

The final section contained several commonly used measures that would serve to distinguish between respondents, specifically the Rosenberg self-esteem scale and BEM's measure of masculinity. Helmreich and Spence's Work and Family Orientation Questionnaire for measuring the achievement motivation and attitude toward family and career was also employed. This measure contains sub-scales for (1) Achievement Motives; (2) Pay, Prestige, and Advancement; (3) Attitude Toward Spouse's Employment; and (4) Relative Importance of Marriage Versus Career.

This survey instrument attempted to gain as complete a picture as possible of engineering students from their pre-college attitudes and abilities to their career plans and life expectations. After the instrument's pretest a few minor changes in wording were made and several new items were added.

Results

This descriptive report reviews what was learned from these students. Results will be presented historically beginning with the respondents' high school experiences. This opening section will be followed by experiences in engineering, non-persistence, issues for minorities and women in engineering, and career plans. For this overview, statistical analyses have been limited to cross tabulations, frequencies, means, and occasionally analysis of variance. Not all the scales or questions have been utilized. Subsequent reports will deal with specific research questions using this information.

Part I
High School Preparation and Experiences

The decision to pursue an engineering degree probably begins to crystalize during high school when academic achievement, interests, and career maturity begin to coalesce. Studies on career maturity generally indicate that women develop vocational maturity earlier than men (Nevell and Super, 1988; Super and Nevell, 1984; and Lunneborg, 1978). These researchers contend that early career decisions can be a problem for women because decisions are often based upon incomplete information about the world of work. As a result young women often limit their options to female-dominated occupations. This section reviews factors that may have influenced career decisions to pursue engineering and academic preparation respondents had prior to entering the university.

Career Decision. The decision to study engineering was commonly made between the eleventh and twelfth grades (Table A). Women tended to make this decision during the latter part of the eleventh grade and into the first year of college. Men generally had reached their decision earlier; usually by the completion of the tenth grade and for some as

early as the ninth grade. The timing of the decision was significantly different between men and women ($p < .10$), as reported in Table A.

Minority groups, both Blacks and "Other Minorities," made early decisions to enter engineering. Blacks indicated a strong interest by the completion of ninth grade. This early career decision may reflect the identification and encouragement of Blacks to pursue science careers as early in their schooling as possible. The "Other Minorities" group which was largely comprised of Asian-Americans, tended to decide by the tenth grade. Their decision may be rooted in a strong cultural emphasis on science and technical careers.

Later in this paper, enrollment group (e.g. Persisters, Leavers) differences will be highlighted. Means for the decision have been included in Table A to permit a cursory comparison at this time. First Timers recalled making their decision earlier than the other groups (early in the tenth grade) while Transfers made the decision during the first year of college. Members of three other groups tended to make the decision at the completion of tenth grade or early in the eleventh grade. A similar pattern held true when the means were further broken out by gender and race. In all groups except Transfers, women made the decision to pursue engineering later than men. White students decided noticeably later than minorities except for Transfers where Blacks decided later and Leavers where "Other Minorities" decided later.

Table A. Decision to Study Engineering

	Overall	Men	Women	White	Black	Other Minority
Overall	2.99	2.93 **	3.06	3.06	2.53	2.76
First Timers	2.75	2.68	2.83	2.82	2.50	2.12
Changers	2.91	2.86	2.97	2.96	2.40	2.60
Transfers	4.10	4.20	4.00	4.14	4.50	3.50
Persisters	2.93	2.72	3.08	3.07	2.43	2.79
Leavers	3.00	2.99	3.01	3.01	2.56	3.30

1 = Before 9th Grade
2 = 9th - 10th Grade
3 = 11th - 12th Grade
4 = Freshman Year College
5 = Sophomore and Junior Year College
6 = Senior and Above College

Factors Influencing Decision. A variety of factors could influence a student's decision to study engineering. Academic success in mathematics and science, a keen interest in mechanical and construction activities, encouragement from a teacher, parent or other adult, and the desire to obtain a certain lifestyle are examples of reasons for becoming an engineer. A list of 25 possible reasons were presented to each respondent who was asked to rate each response for its importance (scale from 1 = not very important to 7 = very important) in the decision to pursue an engineering career.

Factor analysis was employed to identify a smaller set of common dimensions. Five factors emerged from this analysis: External Reasons (salary, job prospects, job security, promotions, and prestige); internal reasons (challenge, service to people, interest in work, flexibility, independence of work, and problem solving); high school experiences (mathematics courses, science courses, math/science ability, career information, and vocational testing); role models (dad's encouragement, mom's encouragement, engineer in family, and friend's encouragement); and activities (construction hobbies, mechanical hobbies, science fair participation, and using computers).

External factors were given as the predominant reasons for pursuing an engineering degree (mean = 5.34), as shown in Table B. Within this set of factors, job prospects (mean = 5.9) and salary (mean = 5.6) had the highest ratings. The next highest rated factor was Internal Reasons with a mean of 4.92. Among the influences in this group, math/science ability (mean = 5.6) and interest in this type of work (mean = 5.5) were the highest rated individual reasons.

Role Models and Activities received ratings of 3.41 and 3.32, respectively. These reasons appeared to be less important in the decision process. The highest rated reasons from both groups were encouragement from father (mean = 3.9) and use of computers (mean = 3.9).

Table B. Reasons for Choosing Engineering as a Career

	REASONS				
	External	Internal	High School Exp	Role Models	Activities
Overall	5.34	4.92	4.34	3.41	3.32
Gender					
Men	5.20 *	4.75 *	4.16 *	3.24 *	3.59 *
Women	5.49	5.11	4.54	3.59	3.03
Race					
White	5.31	4.89	4.31	3.39	3.21
Blacks	5.47	5.07	4.43	3.23	3.90
"Other"	5.43	5.13	4.55	3.90	3.94
Enrollment					
First Timers	5.61	5.16	4.52	3.32	3.43
Changers	5.37	4.87	4.37	3.61	3.64
Transfers	5.56	5.27	4.21	3.38	2.92
Persisters	5.33	5.09	4.33	3.35	3.26
Leavers	5.10	4.61	4.26	3.42	3.24

*Significant difference $p < .05$

Women held slightly stronger External Reasons for entering engineering than men did. Internal Reasons were also rated higher by women. When Activities were considered, men, rated these interests higher. Previous research on women in engineering has shown that women received encouragement from others (Goggins and Lindbeck, 1986; and Noeth, Engen and Noeth, 1984). While women rated Role Models higher than men, their rating of 3.59 was lower than expected. The need for influence of role models may not be as strong prior to college as some researchers have expected. The confusion that these results have caused on this issue suggests that further work needs to be undertaken on the impact of role models on young women in science.

All racial groups held strong External Reasons for being in engineering. Blacks and "Other Minorities" placed slightly more importance on Internal motivations. A somewhat surprising finding was the low score for Role Models: Role Models may not be available to Blacks and their pursuit of engineering may stem from a desire to obtain an education in a successful, well paid occupation. "Other Minorities," on the other hand, indicated that Role Models influenced their career paths. Both Blacks and "Other Minorities" attributed some influence in their decisions to outside interests and activities.

When comparing reasons across different enrollment groups, the ratings were consistent with the overall ratings: each group rated External and Internal Reasons highest and Activities and Role Models lowest. Among groups, however, Leavers rated External and Internal factors lower. With the exception of Role Models, Leavers also rated the other factors lower than the other groups. This consistent pattern seemed to suggest that Leavers did not hold as strong an attachment to or possess the same motivation (particularly internal) for engineering as other students.

Changers may be worthy of further attention. Their ratings send mixed signals with a low Internal Reasons score and a high Activities score, relative to the other groups. In following up on the pre-test sample of Changers, enrollment records indicated that several Changers left engineering the following year. Changers may be prone to leaving engineering once they initiate a switch in major. This issue will be examined more closely later in the paper.

Academic Preparation. Because of the demanding academic requirements in engineering programs, it would be reasonable to expect that students coming to the university would have gained a strong background in mathematics and science and would have demonstrated high academic achievement in high school. Respondents provided self-reported information on the number of science courses they took in high school, their high school grade point average, and an assessment of their academic abilities in comparison to their high school classmates.

Students matriculating into engineering had taken between nine and ten math/science courses (mean = 9.46) in high school (Table C). The differences among various comparison variables were small, yet offered several interesting insights. The majority of men took between six and thirteen math/science courses, averaging 9.68 courses. The number of courses women took ranged from six to eleven. The average for women of 9.22

courses was enough below the men's average to suggest that women usually took one fewer course than men did.

Minorities, both Blacks and "Other Minorities," averaged approximately ten courses, or nearly one more than White students. Blacks indicated that they had taken the most math/science courses in high school (average = 10.22 courses).

Comparing the number of courses taken by enrollment status, all groups averaged between nine and ten courses. Transfer students had taken the most courses in high school, averaging 10.25. Leavers with an average of 9.09 courses appeared to have taken fewer than those who remained in engineering.

When asked about extra-curricular activities, such as science clubs or activities that were oriented toward science or technical interests, 65% indicated that they had not participated in any organized programs. The remaining students had been involved in some activities, usually one (22%), with the remaining students (13%) participating in two or more activities.

Respondents were also asked to rate their abilities in several different intellectual and academic areas in comparison to their high school peers. Ratings were made on a scale from "1" = below average, "4" = average, and "7" = above average. The means are reported in Table C. The overall ratings indicated that students assessed themselves to be above average in overall academic abilities, mathematical abilities, science abilities and problem solving. In all the other areas, the respondents' ratings were slightly above average.

Table C. Academic Preparation and Academic Abilities in High School

		Gender		Race		
	Overall	Men	Women	White	Black	Others
Math/Science Courses (Number)	9.46	9.68	9.22	9.33	10.22	10.08
Final Grade Point Average	3.50	3.41 *	3.60	3.53	3.25	3.46
Abilities in Comparison to High School Peers (Mean)						
Overall	5.22	5.01 *	5.45	5.22	5.39	5.02
Math	5.29	5.14 *	5.45	5.29	5.18	5.36
Science	5.15	5.00 *	5.31	5.16	4.98	5.24
Written	4.70	4.47 *	4.94	4.67	5.04	4.43
Problem Solving	5.12	4.95 *	5.31	5.12	5.23	5.10
Artistic	4.16	4.13	4.19	4.09	4.52	4.50
Spatial	4.69	4.67	4.71	4.67	4.62	4.95
Computer	4.72	4.75	4.68	4.68	5.00	4.79
Speaking	4.36	4.26	4.48	4.29	5.04	4.36

*Significant difference at the .05 level

Women rated their abilities consistently higher among their peers than men did. In several cases, specifically overall, math, science, written and problem solving abilities, the differences were statistically significant ($p < .05$). The one exception was computer skills, where men expressed slightly higher abilities than women. For both genders, artistic skills were about average. Men indicated that writing and oral expression (speaking) were two areas that they perceived average abilities. Women also showed a similar rating for speaking.

Within their peer group, Blacks who chose engineering rated their abilities among their peers generally higher than the other two groups. Mathematical and science abilities appeared to be the two areas where Blacks rated their abilities slightly lower than members of the other groups. "Other Minorities," on the other hand, believed that their particular aptitudes centered on mathematical and science abilities.

Probably the most interesting results came from the ratings breakdowns by enrollment status (Table D). Across all ability areas, Changers rated themselves average (even slightly below average for oral expression), which were the lowest ratings among all groups. Either Changers were incredibly honest (modest may be a better term), or switching majors may indicate a desire to find an engineering program that better suits their abilities. Changers' ratings fall just below those for Leavers, though the latter group's rating tended to be above average. In fact, the ability ratings for Persisters and Leavers were similar. It may be fair to say that at the time these students matriculated to campus, Leavers and Persisters possessed comparable abilities. First Timers and Transfers rated themselves high on nearly every ability, particularly in mathematical, science, problem solving, and overall abilities. Since their high school experience was closer at hand, First Timers' perceptions may reflect a more recent recall of events on which to make comparisons than those who left high school several years earlier.

High school grade point averages provided the final measure of academic achievement. The overall mean for high school grade point was 3.50 (Table C). Women, as expected, had a slightly higher grade point average than men; the difference was statistically significant ($p < .05$). Across racial groups grade point averages ranged from 3.25 for Blacks to 3.53 for Whites. These students came from the tops of their respective classes in terms of academic achievement.

The differences across enrollment groups were less pronounced. Transfers and Changers had slightly higher grades than Persisters and Leavers, but the differences were less than a tenth of a grade point average (Table D).

Table D. Academic Preparation and Academic Abilities by Enrollment Status

	ENROLLMENT STATUS				
	First Timers	Changers	Transfers	Persisters	Leavers
Math/Science Courses (Number)	9.54	9.62	10.25	9.56	9.09
Final Grade Point Average	3.48	3.58	3.57	3.48	3.48
Abilities in Comparison to High School Peers (Means)					
Overall	5.74	4.19	6.05	5.37	5.05
Math	5.79	4.37	6.27	5.44	5.04
Science	5.51	4.26	5.90	5.33	5.01
Written	4.82	4.00	5.12	4.77	4.77
Problem Solving	5.41	4.22	5.78	5.30	5.06
Artistic	3.78	4.01	4.19	4.07	4.52
Spatial	4.70	4.13	4.95	4.77	4.81
Computer	4.74	4.21	5.05	4.89	4.71
Speaking	4.59	3.78	4.54	4.38	4.42

Part II
Experiences in Engineering

Questions in this section cover individual experiences and expectations while in the engineering program. Allocations of time among daily activities, the problems that may have been encountered as an undergraduate engineer, degree to which initial expectations were met in the program, use of support services available from the College of Engineering, and a re-evaluation of the students' academic abilities in comparison to their university peer group will be addressed in this section.

Typical Day. Respondents were asked: (1) to allocate 24 hours of a typical weekday over a list of activities, including time spent in class, time spent studying, and time spent sleeping; (2) to allocate 24 hours over the same list of activities according to an ideal day they would like to spend; and (3) to allocate the 48 hours of a typical weekend over the same list of activities, excluding in-class activities. The allocation of time over a typical day, ideal day, and typical weekend is shown in Table E.

Nearly 30% of the typical day (approximately 7 hours) was spent sleeping and for another 33.7% (slightly more than 8 hours) students were involved in academic activities, both in class and studying. The remaining 36.3% (9 hours) was utilized to relax, socialize, work for wages, complete life necessities (eating, personal hygiene, etc.), and participate in physical fitness. In terms of how time would be "ideally" allocated over a day, students would not change the amount of time in class (less by 10 minutes) and studying. More sleep was requested (about 30 minutes) as was time for physical fitness (slightly over an hour a

day). Where would the time be taken to accommodate sleep and exercise? Generally time from life necessities (down 1.4%) and work (down 5%) would be reduced.

Over the weekend, students usually are not in class. This time is re-allocated to other activities. Proportionally, studying remained the same at 17.3% (actually down nearly 1%) or 8 hours over two days. Students apparently did not feel compelled to spend extra time on academic assignments over the weekend. Rather, more time was spent sleeping, relaxing, completing life necessities, and socializing. In fact, the time spent socializing, was nearly doubled from 7.8% to 14.2%. This change was not unexpected, as students conduct the majority of their social activities on weekends. Time spent in physical fitness and "Other Activities" also increased slightly, including participation in religious activities.

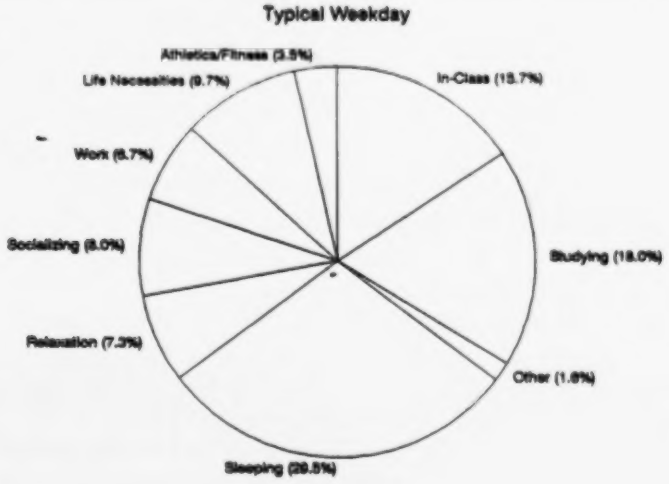
In Table F, the time allocation for men and women, racial groups, and enrollment status are reported. Women spent slightly more time in class and studied a half-hour longer than men. Women also spent more time working and dealing with life necessities than men. Men allocated more time to relaxation, socializing, and physical fitness. For an "ideal" day women would like to spend less time studying (still more than men) and in class, working, and dealing with life necessities and more time sleeping, relaxing and pursuing physical fitness. Men also would cut back on classroom time but increase their study time a few minutes during the day. Like women, men would prefer a few extra minutes of sleep and more time for physical fitness. Men would acquire this time by reducing the amount of time spent socializing (very slightly), working, and dealing with life necessities.

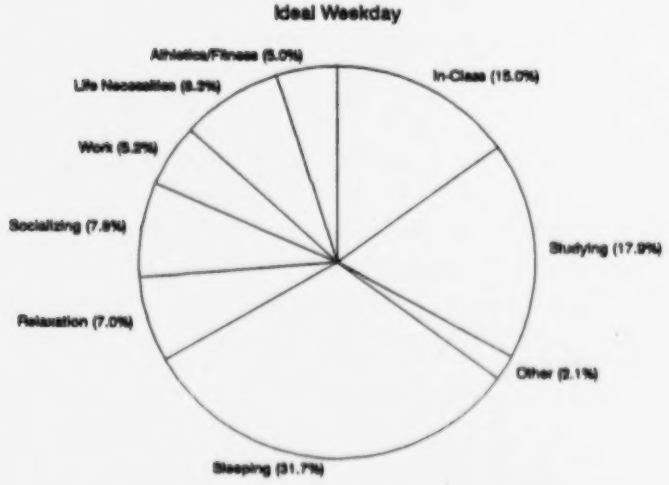
While the differences in a typical and an "ideal" day were subtle for men and women, selected differences were more pronounced by racial groups. "Other Minorities" were spending slightly more time in the classroom and studying more each weekday (40 minutes more than Whites and 33 minutes longer than Blacks). This extra academic time came at the expense of socializing and physical fitness. Blacks found less time for relaxing and sleeping (one hour less than Whites and "Other Minorities") because more time was spent working. Blacks worked nearly twice as long as the other two groups: nearly three hours a day, compared to one and one-half hours for Whites and "Other Minorities." Compared to the two other groups, Whites spent more time relaxing, socializing, and in physical fitness.

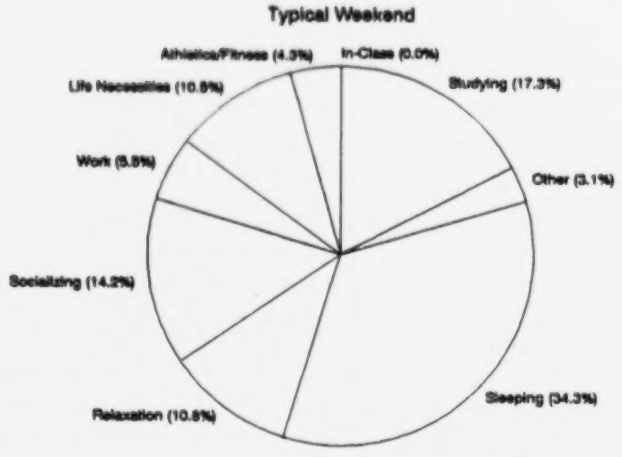
For Blacks, an ideal day would find less time working (about an hour) and more time studying (nearly 40 minutes) and in physical fitness (about 25 minutes). Blacks were the only group that actually increased the amount of academic time under ideal circumstances. All groups desired to spend less time working and life necessities. For Whites and "Other Minorities" studying less with more time for sleeping and pursuing physical fitness was requested. "Other Minorities" showed a particularly sharp decline in the time they would spend studying.

As expected First Timers spent less time in the classroom; they probably were not yet heavily involved in laboratory courses that could add several hours to classroom time. The shortest amount of study time was reported by Leavers (three and one half hours a day) and the longest by Persisters (nearly five hours). Leavers and Transfers spent more time in the classroom each day. First Timers and Leavers spent more time during a typical day

Table E. Breakdown of Typical and Ideal Weekday and Typical Weekend







socializing and relaxing than the other groups. Leavers also tended to sleep longer, work longer, and perform more life necessities than the other groups. Persisters indicated less time was spent socializing, relaxing, and pursuing physical fitness when compared to the other groups' typical days.

Under ideal circumstances, First Timers realized they should be studying more and spending less time socializing. Persisters actually wished they could loosen up and socialize more. All groups wanted more sleep and time to become involved in physical fitness activities. All groups, also, wanted to spend less time working.

Men and women had very similar time allocation patterns over a typical weekend. Where men were likely to spend an additional hour in physical fitness activities, women used this time to study.

Racial differences were more noticeable. Blacks and "Other Minorities" studied more on the weekend than Whites ("Other Minorities" by over an hour) and socialized less. Blacks again report working about twice as much as both the other groups. Blacks spent less time sleeping (about an hour) and more time in "Other" activities which were primarily religious pursuits.

When comparing weekend time across enrollment status, the time allocations for studying and socializing provided the more interesting comparisons. Those students involved in engineering (Persisters, Transfers, and Changers) spent more time studying (about 75 minutes) and less time socializing (about 45 minutes), except for Changers' who socialized more, than Leavers and First Timers. Leavers' weekend patterns varied from those of Persisters: they studied about 55 minutes less and socialized about 20 minutes more.

Expectations. Students enter a program with expectations about how they will perform, the support they will receive, and the learning environment within their college or university. Sometimes the reality of the program does not match with their preconceived expectations. Respondents were asked to compare various dimensions of the engineering and general university environments with their initial expectations at the time they enrolled at the University. The rating scale was a seven point Likert format with the midpoint ("4") designated as "what I expected." The dimensions are listed in Table G. In parentheses are the anchors for the individual dimensions. For example, the scale for Course Load went from "1" - "Much lighter than expected" to "7" - "Much heavier than expected."

Looking down the overall mean ratings' column, only Family Support received a rating very close to "4" or what was expected and several dimensions, Social Life and Career Prospects, were not too far removed from the midpoint. The other dimensions tended to move away from students' expectations.

Respondents encountered a heavier course load, a longer program, and more class schedule conflicts than they initially expected. The biggest shock stemmed from the difficulty of courses which turned out to be much harder than expected. Students also

Table F. Allocation of Time Over a Typical Day, Ideal Day, and Typical Weekend For Students in Engineering According to Gender, Race and Enrollment Status (Percentages)

Activity:	In Class		Studying		Sleeping		Relaxation		Socializing		Work		Life Necessities		Athletics Fitness		Other	
	Typical Day/Ideal Day																	
	Typical	Ideal	Typical	Ideal	Typical	Ideal	Typical	Ideal	Typical	Ideal	Typical	Ideal	Typical	Ideal	Typical	Ideal	Typical	Ideal
GENDER:																		
Men	15.7	15.2	17.2	17.5	30.2	31.9	8.0	7.1	8.6	8.3	6.6	5.4	9.3	8.0	3.9	5.6	0.5	0.9
Women	16.1	15.1	19.2	18.7	29.3	31.0	6.7	7.1	7.5	7.4	7.0	5.1	10.5	8.8	3.0	4.7	0.6	1.2
RACE:																		
White	15.7	14.7	17.7	17.2	29.8	31.5	7.5	7.0	8.2	9.6	6.2	4.8	9.9	8.4	3.4	5.1	1.5	1.5
Black	15.3	15.3	18.1	21.0	26.6	24.5	6.2	6.0	7.0	6.1	12.1	7.9	8.8	6.6	2.9	4.5	2.9	3.1
"Other"	16.0	15.5	20.4	18.6	29.2	30.7	7.0	7.2	6.1	6.7	6.4	5.7	9.8	8.6	2.6	4.5	2.4	2.5
STATUS:																		
First Timers	14.3	14.0	17.9	18.8	29.4	31.6	8.3	6.8	9.2	7.9	5.0	5.0	9.8	8.1	3.9	5.2	2.2	2.4
Changers	15.9	14.7	18.6	17.6	29.6	32.6	6.9	7.0	7.4	7.7	7.3	5.6	9.5	8.0	3.5	5.3	1.3	1.5
Transfers	16.5	15.7	19.3	18.1	29.9	31.6	7.0	7.9	6.9	8.1	5.9	4.3	9.5	8.5	3.7	5.2	3.3	0.6
Persisters	15.8	14.9	20.5	18.9	28.3	31.1	6.6	7.1	6.8	7.5	7.9	5.9	9.6	8.1	3.0	4.4	1.6	2.1
Leavers	16.2	15.8	15.2	16.6	30.2	31.9	7.5	7.0	8.6	8.0	6.8	4.7	10.1	8.9	3.6	5.5	1.6	1.5

Activity:	In Class	Studying	Sleeping	Relaxation	Socializing	Work	Life Necessities	Athletics Fitness	Other
	TYPICAL WEEKEND								
GENDER:									
Men	--	16.6	35.1	11.6	14.7	5.4	10.1	5.2	1.3
Women	--	18.8	34.6	10.3	14.2	5.7	11.3	3.5	1.6
RACE:									
White	--	17.0	34.9	11.1	14.9	4.4	10.6	4.4	3.7
Black	--	18.5	31.2	9.5	11.7	8.6	10.6	3.4	6.6
"Other"	--	21.4	33.7	9.1	11.0	3.2	10.2	5.0	4.0
STATUS:									
First Timers	--	14.9	35.2	11.6	13.1	4.1	10.3	4.2	3.4
Changers	--	19.1	34.6	7.4	15.6	3.8	10.2	4.5	2.3
Transfers	--	20.6	35.5	11.6	12.3	4.3	10.0	3.8	1.8
Persisters	--	19.4	33.1	10.2	12.3	6.7	10.6	4.0	3.3
Leavers	--	15.5	34.8	10.7	14.4	6.1	10.5	4.6	2.3

indicated that Faculty Interaction, Financial Support and Advising were less than they had hoped upon entering the program.

Table G. Congruence of Personal Expectations with Engineering Program (Mean)

		Gender		Race			Enrollment Status				
Dimensions	Overall (Mean)	Men	Women	Whites	Blacks	"Other"	First Timers	Changers	Transfers	Persisters	Leavers
Course Load (Lighter-Heavier)	4.46	4.36 *	4.56	4.42	4.48	4.90	4.44	4.22	4.78	4.59	4.44
Career Prospects (Worse-Better)	4.26	4.15 *	4.37	4.19	4.73	4.37	4.55	4.23	4.53	4.33	3.97
Course Scheduling Conflicts (Fewer-More)	4.36	4.32	4.41	4.23	4.98	5.12	4.38	4.05	4.63	4.51	4.31
Course Difficulty (Easier-Harder)	4.90	4.82 *	5.00	4.88	5.02	5.12	4.85	4.57	4.71	4.96	5.09
Length of Program (Shorter-Longer)	4.62	4.58	4.68	4.57	5.16	4.61	4.65	4.43	4.95	4.86	4.47
Faculty Interaction (Less-More)	3.29	3.32	3.25	3.27	3.33	3.41	3.52	3.42	3.15	3.12	3.23
Financial Support (Less-More)	3.25	3.32	3.18	3.24	3.32	3.32	3.04	3.17	3.07	3.23	3.48
Peer Support (Less-More)	3.71	3.66	3.78	3.74	3.70	3.41	3.97	3.45	3.76	3.80	3.60
Family Support (Less-More)	4.08	3.92 *	4.24	4.05	4.36	4.05	4.53	3.61	4.63	4.30	3.71
Social Life (Less-More)	3.82	3.94 *	3.67	3.84	3.75	3.63	3.89	3.81	3.37	3.69	3.96
Advising (Less-More)	3.33	3.31	3.36	3.33	3.23	3.46	3.51	3.54	3.05	3.23	3.22

* Significant at $p < .05$.
** Significant at $p < .10$.

The perceptions of men and women varied slightly on several dimensions. Women found the course load heavier and the career prospects brighter than men (differences were statistically significant.) Women also reported that they felt the courses were more difficult than they expected. Their average rating of 5.00 was slightly higher than the men's average rating of 4.82. On two other dimensions men and women differed significantly: women reported more support from their families while men found their social life to be closer to their expectations.

All racial groups reported that course work was more difficult and faculty interaction and financial support less than they expected. Both Blacks and "Other Minorities" encountered more course scheduling conflicts than expected and less of a social life when compared to the expectations of Whites. Blacks found career prospects better than they

had anticipated prior to entering engineering. Blacks also enjoyed more family support than they had expected.

When comparing expectation ratings across the enrollment groups, Leavers did not differ noticeably from other groups. Leavers reported more difficulty in their courses (mean = 5.09); but their ratings were only slightly higher than the Persisters' ratings. Leavers reported fewer scheduling conflicts and "as expected" course load in comparison with other groups. Two areas where expectations for Leavers differed from what they expected and differed from other groups were Career Prospects (worse than other groups expected) and Family Support (received less than other groups, except Changers).

The group with the largest discrepancy between their expectations prior to entering engineering and factors they actually encountered was Transfers. On the positive side, Transfers received more family support and found Career Prospects brighter than expected. While their mean for Course Difficulty was 4.71 (tended to be harder than expected), this rating was lower than all other groups with the exception of Changers. On seven items, however, Transfers found that their expectations were not met, usually to a greater extent than other groups. These items included: heavier course load, more scheduling conflicts, longer length of program, fewer faculty interactions, less financial support, less advising, and poorer social life than they had expected.

Problems. Students could face an array of potential problems as they progress through their academic programs. Problems may be related to coursework, health, family or personal issues. Engineering students were no exceptions. In this exercise, respondents were asked to rate twenty-three potential problems they could have encountered while enrolled in the engineering program. These items were measured on a Likert scale from "1 = Not a serious problem" to 7 = "A very serious problem."

The most serious problems faced by students were coursework performance (mean = 5.05), meeting personal expectations (mean = 4.92), and having enough leisure time (mean = 4.07). To facilitate the analysis of all 23 items, factor analysis was employed resulting in six common factors. These factors and the items that loaded on them were extracted:

Personal Problems:	Family problems, problems with personal relationships, emotional problems, social isolation/loneliness, and family responsibilities.
Laboratory Problems:	Lack of familiarity with laboratory equipment, not enough time to feel comfortable with laboratory equipment, and opportunity to participate fully in laboratory exercises.
Free Time:	Having enough time for leisure activities and social life.
Expectations:	Doing as well as expected in coursework, meeting personal expectations, and pressure to most expectations of faculty.
Goals:	Uncertainty about personal goals and uncertainty about career goals.

Discrimination: Faced discrimination based on race and/or gender.

Several items divided their loading on several factors or did not have a strong relationship to any factor. The following characteristics have not been included in the analyses: financing education, length of program, health problems, attitudes of engineering faculty toward students, adequacy of career counseling, and pressure to meet expectations of family and friends. All these omitted factors, except for health problems, were rated as moderately serious (means approached "4" on scale).

Table H provides the means for these factors, by gender, race and enrollment status.

Table H. Seriousness of Problems Faced by Students While in Enginering (Mean)

		Gender		Race			Enrollmentment Status				
							Freshman	Changers	Transfers	Persisters	Leavers
	Overall	Men	Women	White	Blacks	"Other"					
Personal	2.34	2.37	2.31	2.27	2.81	2.59	2.25	2.39	2.72	2.34	2.29
Laboratory	2.57	2.46	2.67	2.56	2.63	2.54	2.40	2.73	2.80	2.72	2.45
Free Time	4.03	3.94	4.12	4.01	4.25	3.96	3.84	4.16	4.21	4.44	3.73
Expectations	4.98	5.04	4.92	4.93	5.54	4.83	4.82	4.74	5.06	4.84	5.28
Goals	3.78	3.78	3.77	3.83	3.60	3.32	3.45	3.69	3.83	3.12	4.52
Discrimination	2.32	2.14	2.50	2.22	3.22	2.25	2.10	2.38	2.59	2.38	2.32

(1 = Not Very Serious, to 7 = Very Serious)

Students encountered their most serious problems as they struggled to clarify their personal and career goals, to live up to their own expectations, and to make choices between leisure activities (Free Time) and academics. Academic problems (students not performing as well as expected) were identified as serious. The remaining problem areas were considered only slightly to moderately serious.

The rating pattern did not change when gender was considered. Men and women rated Personal and Goals factors about the same with the latter factor being rated more serious. Women rated both laboratory and discrimination slightly higher than men, but both factors were only slightly serious. The major problems were encountered in Free Time and Expectations. Men reported more serious concerns with meeting expectations than women (mean = 5.04 compared to 4.92) while women had more problems revolving around Free Time and Academics.

Comparisons among racial groups found Blacks rating the major factors higher than the other two groups except for Goals. Blacks reported their most serious problems, a mean of 5.54, as being unable to meet their expectations, particularly their classroom performance.

The other noticeable rating difference between Blacks and the other two groups was on Discrimination (Blacks' mean = 3.22).

"Other Minorities" ratings were interesting as they were generally lower (less serious) across all dimensions except Personal. "Other Minorities" apparently had fewer conflicts over Goals -- showing a strong commitment to completing their engineering degrees once they had begun. Like the other two groups, "Other Minorities" faced their most serious problems in terms of Academics and Free Time.

A final set of comparisons can be found in Table H for enrollment status. Particular attention was focused on the differences between Leavers and the other four groups. As expected, Leavers reported their most serious problems to involve Expectations (mean 5.28) and Goals (mean 4.52). While the difference in Expectations' rating ranged from .22 to .54, the differential was nearly three times larger for Goals (.69 to 1.4). At this point, the relationship between Academic Achievement and Career Goals has not been completely analyzed; however, a plausible hypothesis would suggest that as a student's academic performance failed to meet personal and programmatic expectations, Career Goals became increasingly disconsonant with reality and as a result, a high degree of conflict was encountered. Leavers, interestingly, reported less serious problems with Free Time than the other groups; once the decision to leave engineering became imminent, time was probably allocated to different activities, reducing the conflicts over Free Time.

Academic Performance. To pursue the issues raised by students over academic performance, several questions were asked that tapped into their expectations and their actual performance. The question, comparing one's academic abilities against one's peers' in the engineering program, similar to the high school achievement question, was repeated. Respondents were also asked to rate their performances in different courses, including mathematics, computer science, engineering, sciences, English, business, social sciences, and humanities. Finally, self-reported cumulative grade point averages were solicited for the end of each grade level.

On the survey, respondents were asked to indicate the number of courses they had taken in a particular area, e.g. mathematics, and to evaluate their performance relative to their expectations on a scale anchored by "1" = Worse than expected to "7" = Better than expected with "4" = As expected. The results on this measure are reported in Table I. Respondents showed a balanced curriculum at this point in their college careers with slightly more courses taken in mathematics, natural and physical sciences, and engineering, and fewer courses in computer science. The ratings matching their classroom performance with their expectations tended to cluster around "4" - or what they had expected. The major exception occurred for mathematics where nearly all respondents indicated that they performed worse than they expected. On the other hand, better performances were realized in English and business courses than respondents expected.

Table I. Expectations on Academic Performance in Selected Areas (Mean)

Courses	Number of Courses Taken (Mean)	ACADEMIC PERFORMANCE: Overall	Gender: Men	Gender: Women	Race: White	Race: Blacks	Race: "Other"	Status: Freshmen	Status: Changers	Status: Transfers	Status: Persisters	Status: Leavers
Mathematics	4.10	3.30	3.23	3.38	3.34	2.86	3.52	3.41	3.66	4.12	3.59	2.70
Computer Science	1.80	3.82	3.73	3.92	3.83	3.81	3.71	3.85	3.90	3.76	4.03	3.60
Engineering	3.80	4.05	3.95	4.15	4.05	4.10	3.93	4.03	4.19	4.21	4.12	3.80
Sciences	4.50	3.92	3.89	3.95	3.95	3.29	3.95	4.02	4.07	4.32	3.94	3.72
English	2.50	4.47	4.26	4.69	4.44	4.47	4.83	4.54	4.38	4.58	4.62	4.34
Business	2.20	4.56	4.69	4.42	4.57	3.59	5.35	4.85	4.84	4.00	4.55	4.53
Social Sciences	2.90	4.18	4.21	4.15	4.22	3.56	4.57	3.91	4.30	4.09	4.05	4.37
Humanities	3.00	4.30	4.25	4.34	4.32	3.81	4.59	5.25	4.51	4.23	4.13	4.34

Men and women did not differ to any great extent on their performance expectations. Mathematics presented a major hurdle for both. Women expressed more confidence in their English while men were pleased with their performance in business courses. In general, both men and women performed slightly worse than they expected in technical and science fields (the exception being engineering courses for women) and much better than expected in the social sciences and humanities.

Racial differences were pronounced, especially when comparing several Black performance - expectation ratings. While every group indicated that their performance in mathematics courses failed to meet expectations, Blacks felt they performed much worse than they had anticipated. Blacks also did not perform as well in business, social sciences, and humanities courses as they had hoped. Conversely, "Other Minorities" performed much better in all social sciences, humanities areas, and particularly business courses, than they had expected.

When comparisons were made across enrollment status, the ratings for mathematics clearly stood out as the major problem area, except for Transfers. Leavers had a major problem with mathematics courses (mean = 2.70), differing as much as one entire rating point from the other groups. Leavers also did not perform as well as they expected in other technical and science areas. For respondents in engineering (Persisters, Changers, and Transfers), their performances in engineering and sciences were generally better than they had expected. Nearly every enrollment group performed better in social sciences and humanities than they had expected.

The above measurements captured the level of dissonance between a student's expected performance in an academic area and their actual performance. Respondents were then encouraged to rate their academic abilities as compared to their peers in engineering classes. The rating scale ranged from "below average" to "above average" with the midpoint being "average."

As the results in Table J illustrate, these students were not modest, rating themselves average to above average across all abilities. In scanning across the table, two observations stood out. Blacks tended to rate their abilities lower than the other two groups, except for computer science and public speaking abilities. Blacks were frank about their abilities in mathematics, slipping below average.

Looking back to Table D, each group experienced tougher competition in college as ability ratings dropped with the exception of written abilities which improved for Whites and "Other Minorities". For Blacks, the rating's drop was twice that of the drop for the other two groups. Blacks encountered more peers with comparable abilities than they had in high school.

Interestingly, Leavers believed their abilities were average or slightly above average on all categories of abilities including mathematics and sciences. Their ratings, however, were somewhat lower than other enrollment status groups. Leavers' ratings dropped further than other groups when compared to their high school ability ratings.

Table J. Academic Abilities in Comparison to Other Members of Engineering Class (Mean)

		Gender		Race			Status				
Abilities	Overall	Men	Women	White	Blacks	"Other"	First Timers	Chang-ers	Trans-fers	Persis-ters	Leav-ers
Overal Academic	4.54	4.53	4.54	4.58	4.04	4.69	4.50	4.72	5.02	4.68	4.26
Math	4.51	4.51	4.51	4.56	3.87	4.76	4.52	7.98	5.17	4.62	4.07
Science	4.59	4.65	4.52	4.63	4.07	4.76	4.53	4.96	4.88	4.60	4.39
Written	4.85	4.76	4.95	4.90	4.68	4.55	4.48	7.94	5.07	4.77	5.06
Problem Solving	4.74	4.79	4.68	4.77	4.29	4.86	4.50	5.03	4.98	4.84	4.62
Artistic	4.09	4.11	4.06	4.10	3.73	4.48	3.78	4.30	4.15	4.06	4.20
Spatial	4.46	4.57	4.34	4.31	3.94	4.54	4.22	4.60	4.46	4.41	4.59
Computer	4.24	4.37	4.10	4.19	4.46	4.57	3.99	4.72	4.15	4.50	4.00
Public Speaking	4.43	4.37	4.50	4.43	4.61	4.21	4.33	4.51	4.25	4.43	4.51

Students' perceptions of their own academic performance, even those rated above average, may not accurately reflect classroom performance. To determine actual performance, respondents were asked to self-report their grade point averages at the end of each academic year. Grade point averages are reported in Table K.

Overall, grade points averaged approximately 3.0 over the three years, showing slight, but continual improvement from freshman to junior years. Women earned slightly higher grade point averages than men, although the difference nearly disappeared by the end of the junior year. "Other Minorities" reported the highest grade point averages, slightly higher than Whites'. Blacks had the lowest averages by year. Most distressing about the Blacks' trend was the lack of improvement in grade point averages over time. Grade point averages for Blacks, combined with results already presented, are illustrative of a very frustrating situation for Blacks as they attempt to make their way through the engineering program.

Persisters had very consistent grades between years. Leavers, as expected, had the lowest grade point averages at the end of their freshman year and displayed improvement over their sophomore and junior years. The differences in grades between Persisters and Leavers underscored the academic dimension for continuing in the program.

Table K. Grade Point Average by Year in School

	YEAR		
	Freshmen	Sophomore	Junior
Overall	2.98	2.97	3.02
Men	2.94	2.95	3.02
Women	3.03	3.00	3.04
White	3.00	2.99	3.06
Blacks	2.68	2.63	2.52
"Other"	3.11	3.08	3.09
First Timers	3.03	3.16 *	--
Changers	3.16	3.09	3.13
Transfers	3.27	3.16	3.22
Persisters	3.11	3.18	3.17
Leavers	2.74	2.76	2.88

*Several freshmen did not earn sufficient credits in their first three terms to attain sophomore status and were still freshmen at the time the sample was drawn. When the survey was administered, they may have become sophomores; for convenience, were included as First Timers which reflects the original catagory from which they were selected.

Support services. Students facing academic, career and personal conflicts or problems have a variety of support services available to assist them. Respondents were asked their familiarity with the support services and program options available within the College of Engineering or the appropriate office, specifically undergraduate advising for

no-preference freshmen. Respondents were further asked if they utilized these services and, if so, they were requested to rate those services as to their helpfulness to them.

Students were generally aware of the academic and support services available on campus, as shown by the response pattern in Table L. Advising, tutoring, and course and curriculum enrollment options were the most familiar, as were engineering student organizations. Programs that targeted specific groups, e.g. women and minorities, were also recognized by the client groups. Women and Blacks reported a slightly higher degree of awareness, particularly in the networking programs, such as organizations and use of faculty. One interesting observation found when comparing enrollment status groups: Leavers and First Timers were less aware of the availability of faculty to assist them.

Table L. Awareness of Support Services and Programs Available to Engineering Students (% Yes)

	Overall %	Men %	Women %	Whites %	Blacks %	"Other" %	First Timers %	Chang-ers %	Trans-fers %	Persis-ters %	Leav-ers %
Tutoring	88	88	91	88	100	86	91	87	90	92	86
Flexibility to Switch Courses	74	76	71	74	79	69	74	76	66	80	70
Flexibilitiy to Switch Majors	84	84	84	86	76	69	79	87	83	83	88
Advisors	91	92	92	92	96	88	90	94	93	94	90
Engineering Student Organizations	84	80	90	84	96	74	82	89	85	91	78
Women's Support Group	60	52	75	62	66	45	68	58	70	70	51
Equal Opportunity Program	48	52	49	45	84	62	43	46	61	54	47
Available Faculty (Outside Class)	67	68	72	66	73	62	61	71	83	74	60

Actual student use of these services varied widely. Nine-two percent (92%) sought assistance from advisors throughout the year. Slightly half, 53%, sought help from faculty outside of class, 36% were involved in student organizations, and only 18% used tutors.

Men were less likely to seek assistance from available resources, particularly in their use of advisors, tutors, and student organizations. Men sought assistance from faculty at approximately the same rate as women. Blacks showed a higher use of tutors and student organizations when compared to other groups, including utilization of the equal opportunity program. All racial groups reported very similar use of advisors and faculty.

Table M. Utilization of Services from the Various Sources (% Used)

	Overall %	Men %	Women %	White %	Black %	"Other" %	First Timers %	Changers %	Transfers %	Persisters %	Leavers %
Advisors	92	88	97	92	93	86	92	92	93	94	89
Faculty (Outside Class)	53	52	59	53	56	57	39	59	63	71	44
Tutors	18	13	23	12	64	33	16	13	19	24	17
Student Organizations	36	28	53	33	70	31	23	49	49	52	24
Equal Opportunity Program	7	8	4	1	55	12	4	5	2	16	5

Except for First Timers who had limited exposure to engineering faculty at the time of this survey, Leavers showed a very low utilization of faculty, tutors, and student organizations. Leavers apparently avoided building a support network to facilitate their progress in the program. Persisters used tutors and sought faculty outside classroom contacts to a greater extent than the other enrollment groups.

How useful were these services for students who used them? According to reported ratings, helpfulness of these services ranged from average to below average. Advisors, faculty and student organizations received average ratings. Men displayed a more negative opinion of these services, rating only faculty as slightly above average. Women found these resources to be more helpful than men, rating all services slightly above average with the interesting exception of women's support groups.

Blacks also found helpful support from these resources, particularly the equal opportunity program and student organizations where ratings exceeded 5.0. Whites on the whole tended to rate resources more negatively than other groups although advisors and faculty were rated average. A consistent pattern emerged as Leavers expressed little use provided by these resources. All rating means were below average with comments suggesting that some Leavers were particularly unhappy with the advising they received.

Table N. Ratings on the Helpfulness/Usefulness of Service to the Student (Mean)

	Overall	Men	Women	Whites	Blacks	"Other"	First Timers	Changers	Transfers	Persisters	Leavers
Advisors	4.04	3.68	4.40	4.00	4.04	4.60	4.54	4.00	4.18	4.36	3.47
Women's Support Group	2.90	1.66	3.61	2.83	3.44	2.79	3.33	2.78	2.75	3.17	2.38
Faculty	4.22	4.17	4.28	4.20	4.18	4.58	4.08	4.50	4.39	4.47	3.76
Equal Opportunity Program	2.76	2.76	2.46	1.56	5.09	2.69	2.73	1.59	1.33	3.60	2.61
Tutors	3.72	3.07	4.22	3.32	4.77	3.95	4.63	2.45	3.36	4.02	3.59
Student Organizations	4.07	3.47	4.20	3.89	5.02	3.94	3.86	4.21	3.82	4.37	3.69

Another area of support, not provided by the institution, was a friendship network developed while in school. Respondents provided the number of close friends they have had at Michigan State and also indicated how many of these friends were enrolled in engineering. Respondents reported an average of 7.24 friends. The mode (most commonly reported) was 10; yet the median (number of friends) was 5. In other words, students were grouped at both ends of the scale -- some had very few friends while others had a large number of friends. The number of close friends in engineering averaged 2.43 (34%). The mode, however, was zero or no friends while the median was 2. A few students have a large number of close friends in engineering, but half the students had two or fewer friends, and many had none.

Men reported slightly more friends than women on average (Table O). For men the mode was three (3) friends and the median was five (5). In other words, the number of friends a man had was fairly consistent, between 3 and 7. For women, the opposite was the case. Women's mode was ten (10) friends and their median number of friends was five (5). Women tended to be in two groups: one with a large number of friends and another with a small number of friends. The most common response for the number of friends in engineering was zero for men and women. For those with friends in engineering, men reported more friends in engineering (40%) than women (33%). Women apparently developed fewer friendships with other students also in engineering.

Blacks and Whites generally had several more friends than "Other Minorities." Whites appeared to separate into individuals with "lots of friends" or "few friends" while the other two racial groups were more consistent. "Other Minorities" reported at least one of their friends was in engineering while the most likely response from Blacks and Whites was none. Blacks overall reported having more of their friends in engineering (41%) than the other groups.

Table O. Number of Friends at the University and in Engineering

	Number of Friends			Friends in Enginering			
	Mode	Median	Average	Mode	Median	Average	%
Men	3.0	5.0	6.83	0	2.0	2.72	40
Women	10.0	5.0	6.47	0	1.0	2.12	33
Whites	10.0	5.0	6.84	0	2.0	2.23	33
Blacks	3.0	4.0	7.32	0	1.0	3.02	41
"Other"	3.0	4.0	5.05	1.0	1.0	1.53	30
First Timers	5.0	5.0	6.37	0	2.0	2.07	32
Changers	10.0	7.0	8.48	0	2.0	2.53	30
Transfers	3.0	4.0	4.41	2.0	2.0	2.44	55
Persisters	10.0	5.0	7.42	1.0	2.0	2.61	35
Leavers	4.0	4.0	5.90	0	1.0	1.92	32

Transfers had the fewest number of friends, but they reported over half (55%) of their friends were in engineering. The other enrollment groups ranged from 30% to 35%. Leavers also had fewer friends, in comparison to those who stayed in engineering, and the proportion of their friends in engineering was 32%, or about one friend per respondent. The most common response for Leavers was none. Apparently, those who persisted in engineering had a slightly larger network of friends within engineering than those who left for other majors.

Part III
Moving On: Those Who Leave Engineering

It would be unrealistic to expect that all students who entered engineering would continue in the program to graduation. Students switch to other majors for a variety of reasons from grades to changes in career interests. Where Leavers go and why is investigated in this section.

Two hundred and eighteen (218) students in this sample left engineering to pursue studies in other programs. Five students entertained a no preference status as they examined alternative majors. The remaining 213 sought a variety of programs throughout the university. The largest number, 64 (30%), enrolled in the College of Business, primarily in accounting, general business administration, financial administration and materials and logistics management. However, the program attracting the most Leavers was packaging in the College of Agriculture where 34 (16%) of the students enrolled. Another 15% remained in a natural science field, usually mathematics, opting to pursue degrees in the colleges of Natural Science or Lyman Briggs. The complete list of final destinations is presented below:

DESTINATION AFTER LEAVING ENGINEERING	TOTAL NUMBER ENROLLED
College of Agriculture	42
Packaging	34
College of Business	64
Accounting	10
General Business	9
Financial Administration	9
College of Human Ecology	6
College of Natural Science	28
Mathematics	10
College of Education	8
College of Communication Arts and Sciences	20
Telecommunications	11
College of Arts and Letters	10
James Madison	3
College of Social Science	28
Social Science MDP	6
Landscape Architecture	5
College of Nursing	1
Lyman Briggs	5

Reasons for selecting a new major ranged from finding a program requiring less mathematics to one that matched more closely their career goals. Respondents were invited to answer the following questions: "What were the primary and second most important reasons for selecting a new major?". Answers grouped predominantly in these areas: interest in or knowledge of the field (38%), good employment opportunities (8%), acceptable grade point average (7%), and people-oriented field (6%). The remaining

comments were spread over eighteen additional response categories, including utilization of mathematics and science, availability of role models, and simply, easier.

Respondents also provided reasons for leaving the engineering program. The seven commonly mentioned reasons were grades (17%); lost interest (21%); mathematics abilities (13%); program failed to meet expectations (10%); changing career goals (9%); program too technical (7%); and not qualified for program (7%). For some the switch was prompted by poor academic performance or a questioning of one's abilities in mathematics and science. Two additional reasons emerged: (1) the content of the engineering program failed to engage the interest of the student; and (2) career interests shifted as the student matured and/or experienced new subjects at the university.

To pinpoint more closely the possible reasons for leaving the engineering program, Leavers were asked to rate the importance of eighteen reasons for their decision to leave. Using factor analysis, seventeen reasons were grouped into six factors: Support (unable to access faculty, lack of support services, and lack of peer support); Time Pressure (scheduling conflicts, five years to complete program, family pressure to complete school in four years, and peer pressure to change majors); Discrimination (experienced discrimination in classroom or laboratory, discrimination in work-place would hinder career, and poor job prospects); Personal (financial considerations, personal problems, and lack of family financial support); Course Work (course work performance and course work difficulty); and Goals (incompatibility with career goals and incompatibility with personal goals). The eighteenth problem, lack of professional role models, loaded equally on two factors, and thus it was not included with any factor.

Considering only individual reasons for the moment, the major reasons Leavers gave for leaving the program (important to very important) were course work performance (mean = 5.0), course work difficulty (mean = 4.7), incompatibility with personal goals (mean = 4.4) and incompatibility with career goals (mean = 3.7). All the other reasons generally received low scores. The composite scores for the factors confirmed this with Course Work and Goals having means above "4" and the remaining four factors below 2.5, as shown in Table P.

Table P. Seriousness of Problems Faced by Those Who Left Engineering

	Overall	Sex		Race		
		Men	Women	White	Black	Other
Support	2.53	2.67	2.38	2.48	3.11	2.91
Time Pressure	1.67	1.67	1.57	1.62	1.46	2.73
Discrimination	1.49	1.40	1.60	1.43	1.64	2.58
Personal	1.89	1.80	1.98	1.83	2.47	2.30
Course Work	4.87	4.96	4.75	4.79	5.77	5.32
Goals	4.04	4.01	4.08	4.02	4.29	4.18

(1 = Not Important, to 7 = Very Important)

Men and women reported little differences in their ratings, although men rated Course Work performance as slightly higher in importance to their decisions. Race differences emerged, however. Blacks and "Other Minorities" indicated that Course Work performance was very important to their decision in comparison to Whites and their Goals scores were also higher than Whites. On the other factors, there was generally more agreement on the factor's importance to the decision. Interestingly, "Other Minorities" rated Discrimination higher than Blacks by nearly one rating point. Apparently those "Other Minorities" who left the engineering program may have encountered or may have been more sensitive to discriminatory situations.

Several differences were observed among Leavers when they were grouped according to their new majors (Table Q). Course Work and Goals were the most serious problems across all groups. An interesting observation can be drawn by examining the ratings for Performance and Goals. For Leavers transferring to agricultural and natural science disciplines, academic performance was the major reason to transfer; their goals did not necessarily change. Leavers transferring to the College of Agriculture chose packaging which has a strong engineering emphasis; thus, allowing them to continue an "engineering" type career. Leavers to natural sciences were primarily students wishing to pursue careers in computer science. Computer science careers can also be pursued with a degree in mathematics which made the decision to switch major more a reaction to grades than incompatibility of goals. In examining the alternate careers to engineering that respondents listed, Leavers that transferred to agriculture, natural science, and business were more likely to be in their second career options (especially business) than Leavers who went elsewhere.

Leavers to social science disciplines and "other" (e.g. education, arts and letters, communication) fields expressed more serious problems over career goals. Not only were these students struggling with their course work but they were having problems with their career and personal goals too. They tended to pursue academic programs that would lead to career paths not articulated among their career options at the time they entered college. Their decision to leave engineering may have resulted from exploring new fields when taking general education courses, or they may have decided out of frustration (path of least resistance).

Table Q. Seriousness of Problems Faced by Those Who Left Engineering, Listed According to New College

	College				
	Agriculture	Business	Natural Science	Social Sciences	Other
Support					
Unable to Access Faculty	2.49	2.24	1.86	2.47	3.20
Lack of Support Services	3.22	2.29	2.63	2.65	3.52
Lack of Peer Support	2.46	1.93	2.26	2.06	3.07
Time Pressure					
Scheduling Conflicts	1.57	1.52	1.71	1.35	1.62
Five Years to Complete Program	1.81	2.02	1.60	2.06	2.07
Family Pressure to Complete School in Four Years	1.57	1.58	1.69	1.29	1.62
Peer Pressure to Change Majors	1.58	1.63	1.46	1.37	1.65
Discrimination					
In Classroom or Laboratory	1.43	1.34	1.63	1.47	1.65
Work Place	1.32	1.10	1.57	1.18	1.62
Poor Job Prospects	1.65	1.49	1.74	2.23	1.50
Personal					
Financial Considerations Personal	1.95	1.54	1.74	1.53	2.05
Personal PRoblems	2.00	1.71	2.09	2.23	2.70
Lack of Family Financial Support	1.86	1.54	1.77	1.41	1.82
Course Work					
Performance	5.24	4.98	4.77	5.06	4.90
Difficulty	4.86	5.00	4.40	4.41	4.44
Goals					
Incompatible Career Goals	3.40	3.91	3.29	4.82	3.85
Incompatible Personal Goals	4.05	4.56	3.26	5.29	4.75
Role Models	2.38	2.17	2.09	3.06	2.62

The moderately serious rating by "other transfers" for lack of support services suggested that career guidance may not have been sought nor offered to those students. The higher rating by social science students on Role Models further suggested frustration with finding a suitable career path: there was no person the students could identify for assistance in career guidance.

After leaving engineering a reasonably accurate predication of students' directions can be determined by the compatibility of their goals. Students who do not have clear career options in mind will tend to drift into the social sciences/arts and letters disciplines. Those

with more defined career options will likely transfer to packaging, business, or natural sciences.

How satisfied were Leavers with their choice of career paths as found in their present academic major? Leavers were asked this question and in response they were very satisfied (mean = 5.85 on a "7" point scale). Women were slightly more satisfied than men with a mean of 5.94, compared to 5.77 for men. Racial groups reported similar rating with means of 5.87, 5.58, and 5.75 for Whites, Blacks, and "Other Minorities," respectively.

Part IV
Images of Engineering

Attracting students and retaining them in engineering programs can depend, to some extent, on the image students perceive of the environment around them. Students who feel stigmatized or labeled may react by avoiding the environment or switching to a more comfortable one. In this part of the study, an attempt was made to see how engineers stereotype themselves and to examine specifically the issues of Blacks and women in engineering.

Stereotyping. No summer would be complete without the release of a film involving nerds; if this movie took place on a college campus, the nerds would likely be engineering students. The image of students with slide rules clipped to their belts has given way to computer freaks and other gadgetry. Nevertheless, the image that one may often conjure about engineers would depict a highly intelligent, anti-social, and often peculiar White male. Many engineers may elect to challenge this personality profile.

To inquire about views of engineers themselves concerning personality traits, each respondent was asked to rate thirty traits as characteristic of engineers ("1" = not at all characteristic to "7" = very characteristic). From their ratings these following traits were selected as very characteristic of an engineer: intelligent, mathematical, dedicated, orderly, well-respected, self-confident about work, practical, and liking structure. All these characteristics had overall means greater than 5.0. Characteristics that respondents felt did not describe engineers included: feminine, unimaginative, follower (rather than leader), enjoys art and literature, cold personality, and physically attractive.

Factor analysis was used to reduce the thirty variables to four common factors: Nerdish, All-American, BYCWM, and Robotech. Labels for these factors were created, partially "tongue-in-check." However, this injection of humor should not detract from the message that this stereotyping exercise conveys. Characteristics that describe each factor were:

Nerdish:	Introverted, follower, cold personality, shy, boring, unimaginative and cares more for things than people.

Robotech: Intelligent, mathematical, orderly, likes structure, dedicated, practical and well-respected.

BYCWM: Masculine, White male, and conservative.
(Basically your conservative White male.)

All-American: Sense of humor, sociable, relaxed, happy, enjoys sports, friendly, outgoing, enjoys art/literature, physically attractive, and well-adjusted.

Two characteristics, self-confident about work and enjoys hobbies, loaded equally on two or more of the four common factors, and femininity did not load on any factor. These three characteristics have not been included in the four composite descriptions given above.

From Table R, engineering students, including those who have left engineering, did not perceive themselves as nerds (the least characteristic set of variables) nor did they particularly associate with the All-American image. Engineers were viewed as individuals who like order, structure, and mathematics (Robotechs) -- essentially accurate expectations given the scientific and technical nature of the field. Respondents also indicated that BYCWM was characteristic of engineers: simply, engineering was a conservative, White male environment.

There was little disagreement between genders or among racial groups and enrollment status on the ordering of these stereotypes. Blacks sensed the white male characteristics slightly more than the other groups. Leavers viewed engineers as being slightly more nerdish than their peers whom they left in engineering.

Table R. Stereotyping of Engineers (Means)

	Overall	Gender		Race		
		Men	Women	White	Black	Other
Nerdish	3.59	3.74	3.43	3.59	3.66	3.51
All-American	3.73	3.69	3.78	3.72	3.81	3.85
BY(WC)M	4.28	4.29	4.27	4.27	4.54	4.01
Robotech	5.60	5.50	5.70	5.60	5.70	5.39

	Enrollment				
	First Timers	Changers	Transfers	Persisters	Leavers
Nerdish	3.28	3.76	3.65	3.86	3.86
All-American	3.82	3.83	3.65	3.62	3.62
BY(WC)M	4.28	4.51	4.37	4.33	4.33
Robotech	5.76	5.58	5.46	5.54	5.54

Blacks. Several Black students who commented on their experiences admitted, on the one hand, having problems and being frustrated with successfully completing the program and, on the other, anger about being labeled "special" students because of entrance requirements and assistance programs. Blacks encountered an array of problems from high school preparation to acceptance in the classroom. Enrollment groups, however, may differ in their views of problems affecting Black students' abilities to complete the engineering program. To determine the problems Black students encounter in engineering, respondents were asked to rate nineteen potential problem areas on a scale from "1" = Definitely Not to "7" = Very Definitely.

No single problem received a rating above five. Finances were rated highest at 4.9. This may explain the reason Black students were working nearly twice as many hours during the week and on weekends as other students. Other areas of concern included: discrimination in the work place, high school preparation and role models: all with means around 4.5. Clustered between 3.5 and 4.0 were these potential problem areas: language skills, peer pressure against being in a White male-dominated field, not being taken seriously as an engineer, and labor market discrimination. The remaining eleven problems were considered to be less serious for Blacks by all respondents.

To facilitate the discussion, factor analysis was used to reduce the nineteen variables to three common factors. The External factor captured those problems usually considered outside the individual's ability to influence. The Internal factor was comprised of problems that were likely to be under the control of the individual. The third factor encompassed high school preparation and the financial support to attend college. Role models which received a moderate to serious rating loaded equally on all factors; as a result, this problem was not included in the discussion. The three factors and the problems that loaded on each factor were:

External:	Discrimination in the labor market, discrimination in the work place, discrimination by the university system, discrimination by faculty, lack of friendship networks within engineering, not taken seriously as an engineer, and peer pressure against being in a White male field.
Internal:	Hard work, ability, career commitment, motivation to finish program, willingness to take five years to complete degree, and language s
Preparation/Support:	High school academic preparation and finances.

Mean ratings for the three factors are provided in Table S. External factors were rated slightly more serious than Internal factors. Clearly, the problems faced by Blacks centered on their preparation and financial support. No noticeable differences in ratings existed between men and women and among enrollment groups. Within racial groups, however, the differences were more pronounced. Blacks rated all three factors higher than the other two groups with means that indicated Blacks felt they faced a variety of serious problems. Particularly serious were Preparation/Support and External factors with means of 4.83 and

5.95, respectively. While still rating internal factors higher than the other groups, Blacks considered these problems to be only moderately serious.

Table 5. Problems Faced by Blacks in Engineering (Means)

	Problem Areas		
	External	Internal	Preparation
Overall	3.46	3.08	4.69
Gender			
Men	3.43	3.03	4.78
Women	3.49	3.12	4.59
RACE			
Whites	3.29	2.98	4.53
Blacks	4.83	3.86	5.95
"Other"	3.65	3.28	4.96
ENROLLMENT			
First Timers	3.54	3.11	4.46
Changers	3.32	2.99	4.54
Transfers	3.40	3.22	4.68
Persisters	3.45	3.10	4.70
Leavers	3.48	3.05	4.90

Because composite factors might mask important perceptual differences on selected problems that Blacks face, the problems were examined separately within each category. Those problems which loaded equally and were not included previously have also been included. Means for each problem by racial group can be found in Table T.

Everyone recognized the problems that Blacks had when acquiring their high school academic preparation and financing their education. Blacks were particularly concerned about finances. Most interesting about these ratings were some patterns observed among racial groups. Whites believed that internal problems such as ability and hard work were not too serious. Likewise they recognized that discrimination existed in the work place. At the same time, Whites did not perceive institutional (university and faculty) discrimination to be more than a slight problem. In addition, Whites felt that Blacks possessed the ability and commitment to pursue engineering; yet, Whites may have failed to appreciate the interactions within the engineering environment that impinge on Blacks and their abilities to complete the program.

Blacks, in most cases, rated all problems higher than the other groups. Blacks held strong beliefs that the external problems were serious: not only discrimination in the work place, as one may suspect, but discrimination by the university and the faculty. Blacks also considered the lack of friends in engineering to be a problem.

Blacks came down hard on their own abilities, questioning their motivation to complete the program, language skills, and commitment. Whites and "Other Minorities" did not view Blacks this way; at least the ratings were not as high. Blacks may be placing a lot of pressure on themselves to perform which may result in seriously questioning their own abilities. Certainly, Blacks expressed frustration in comments that they came prepared to undertake college work but found it difficult to stay the course, especially in mathematics.

Table 7. Specific Problems Faced by Blacks in Engineering According to Racial Group

	Whites	Blacks	Other
External			
Discrimination - Work Place	4.46	5.71	4.78
Not Taken Seriously	3.52	4.98	3.27
Peer Pressure - Being in Field	3.80	4.12	3.71
Discrimination - University	2.39	4.62	3.29
Lack of Friendship Networks	2.87	4.91	3.19
Discrimination - Faculty	2.50	4.55	3.34
Discrimination - Labor Market	3.45	4.74	3.95
Internal			
Motivation of Complete Program	3.36	4.98	3.41
Ability	2.54	3.09	2.68
Hard Work	2.56	3.30	3.29
Career Commitment	2.62	3.25	3.15
Language Skills	3.92	3.98	3.76
Five Years to Complete Degree	2.87	4.44	3.37
Preparation/Support			
High School Preparation	4.38	5.75	4.61
Finances	4.68	6.16	5.32
Role Models	4.14	5.11	4.00
Career Counseling	2.78	4.25	3.32
Peer Pressure - Academic Achievement	2.76	4.07	3.44

Women. Even though women have been enrolling in engineering programs in increasing numbers, observers of women in these programs have suggested that women face a set of unique problems, such as lack of role models, work place discrimination, and adjustment to laboratory situations. A list of twenty potential issues was presented to respondents for their rating of how likely each issue was a problem for women.

According to the ratings, women apparently faced few serious problems. However, identified problems could influence a woman's decision to remain in the field. The highest rated problem was "not being taken seriously as an engineer." Also rated serious were discrimination in the work place and peer pressure against being in a male-dominated field. Two other moderately serious problems were also identified: lack of role models and male domination in laboratory situations.

Again using factor analysis, this set of problems was reduced to three common factors:

External: Discrimination in the work-place, not taken seriously as an engineer, peer pressure against being in a male field, discrimination by faculty, male domination in laboratory situations, discrimination by university system, no friendship networks in engineering, and lack of role models.

Internal: Language skills, hard work, five years to complete the degree, finances, motivation to complete the program, career commitment, ability, career counseling, and high school preparation.

Laboratory: Previous familiarity with lab equipment and not enough time with lab equipment.

From the aggregate factor means, reported in Table U, the problems faced by women were considered to be moderately serious, especially external and laboratory problems. Men and women did not differ to any appreciable extent though women rated External problems slightly higher.

Table U. Ratings on the Seriousness of Problems Facing Women in Engineering

	External	Internal	Laboratory
Overall	3.57	2.30	3.01
Gender			
Men	3.50	2.32	3.02
Women	3.64	2.26	3.00
RACE			
Whites	3.43	2.18	2.93
Blacks	4.73	3.19	3.38
"Other"	3.53	2.54	3.31
ENROLLMENT			
First Timers	3.51	2.14	3.01
Changers	3.46	2.26	3.06
Transfers	3.48	2.39	3.10
Persisters	3.66	2.28	3.12
Leavers	3.61	2.33	2.86

Blacks' ratings on problems facing women were consistent with their ratings on Black problems. Ratings by Blacks were higher across all factors than ratings from the other two groups. Blacks and "Other Minorities" both observed more problems for women in

laboratory situations than White respondents. The external discrimination that Blacks feel in their own experience carried over to their views of women's problems.

Leavers did not perceive problems as serious as other enrollment groups which may be attributed to their leaving engineering before becoming heavily involved in the engineering program. Both Persisters and Leavers rated the external factor slightly more serious than the other groups. It is interesting that Persisters and Leavers hold a very similar view of the external problems women face in engineering, but have chosen different academic options.

Do men view the problems women face differently than women? The analysis of major factors suggest not. On individual items, however, several significant differences were discovered. Women viewed discrimination (work-place and faculty) and factors that may contribute to discrimination, like difficulty in financing education and career counseling, as slightly more serious than men (Table V). Men differed from women in their belief that hard work, career commitment and lack of role models -- Internal factors -- were more serious problems for women. Everyone agreed that women were not being taken seriously in engineering where means of 4.77 and 4.60 were reported for women and men, respectively.

Another interesting question was whether women in different enrollment groups differed on how they viewed the engineering environment for women. Surprisingly, few differences were found (Table V), usually between First-Timers and Leavers.[1] Persisters and Leavers rated high school preparation and familiarity with laboratory significantly different. First Timers' responses may reflect the fact that they have only been at the university a short time and may not have experienced laboratory situations and potential work environments to gain a clear understanding of the problems women may face.

Males' domination in laboratory situations was rated as a serious problem, especially among Persisters. From comments by several female respondents, women tended to be more deliberate in their laboratory exercises, taking time to make sure everything went right. Men, they complained, wanted to finish the experiment quickly and get out of the lab. If the exercise was proceeding too slowly, men were likely to take control in order to finish sooner. Women could either go along and finish or start over, usually by themselves.

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[1]Because of sample sizes, Transfers and Changers were grouped with Persisters for this analysis.

Table V. Women's Problems in Engineering as Perceived by Men and Women

	Gender		Women		
	Women	Men	First Timers	Persisters	Leavers
EXTERNAL					
White-Male Field	4.03	4.03	4.10	4.10	3.86
Peer Pressure	2.54	2.48	2.24 +	2.54	2.76
Role Models	3.66 **	3.93	3.37	3.71	3.78
Discrimination in Work Place	4.63 *	4.15	4.49	4.78	4.48
Taken Seriously	4.77	4.60	4.61	4.90	4.65
Male Dominatd Lab	3.93	3.70	3.69	4.04	3.93
Discrimination Faculty	2.80 *	2.47	2.41 ++,*	2.92	2.86
Discrimination - University	2.36	2.39	2.41	2.54	2.70
Friendship Networks	2.73	2.76	2.42 +	2.67	3.05
INTERNAL					
High School Preparation	2.41	2.39	2.22 ++	2.32 **	2.69
Hard Work	2.00 *	2.26	1.95	1.96	2.09
Finances	2.63 *	2.34	2.54	2.61	2.73
Length Program	2.27	2.38	2.00 **	2.38	2.27
Career Commitment	2.29 *	2.54	2.07 ++	2.26	2.51
Language Skills	1.68	1.82	1.73	1.68	1.65
Career Counseling	2.50 **	2.28	2.47	2.48	2.56
Motivation	2.86	2.77	2.66	2.85	3.01
Ability	1.85 *	2.35	1.80	1.79	2.00
LABORATORY					
Familiarity - Lab	3.11	3.15	3.07	3.29 **	2.86
Comfortable - Lab	2.87	2.88	2.95	2.92	2.73

* - Significant difference ($p < .05$) between adjacent columns
** - Significant difference ($p < .10$) between adjacent columns
+ and ++ - Significant differences ($p < .05$ and $< .10$, respectively) between First Timers and Leavers

Part V
Career Expectations

In this section, several dimensions of the career expectations of respondents, specifically graduate school aspirations, starting salary expectations, and desired job characteristics will be reviewed. An examination of occupational career paths and work activities will be presented in a separate piece to accommodate the coding of occupations. The work and achievement scale will not be introduced at this time.

Approximately 44% of the respondents (262) indicated that they had plans to pursue a graduate degree at some point in their career and another 40% were uncertain. The remaining 16% expressed no interest in pursuing an advanced degree. The majority of respondents (60%) who plan to continue their education would obtain a master's degree as their terminal degree.-Fifteen percent (15%) anticipated completing a Ph.D. and 5% were interested in professional degrees. When asked to specify the field they wished to pursue, respondents actually listed professional programs more frequently than the 5% suggested. The actual breakdown found 35% selecting engineering, 30% opting for business, 30% seeking professional degrees such as law and medicine, and 15% preferring "other" programs. These "other" programs were usually listed by Leavers who were now in a variety of different academic majors.

Respondents had a fairly good idea of their starting salary expectations. The overall average placed starting salaries at approximately $26,879. However, the range most often selected was $29,000 to $33,000. These figures correspond closely to currently reported starting salaries.

Women and men expected nearly the same starting salaries with women's being slightly higher salaries at $27,200 compared to $26,800 for men. The only groups where women's starting salaries failed to exceed men's were for (1) Leavers where women tended to go into teaching, humanities, or social sciences while men were more likely to go into business and other technical fields; and (2) Changers, where women moved into lower paying engineering programs than men.

Racial comparisons of starting salaries showed that Blacks expected slightly higher salaries than the other two groups. The calculated averages were $26,400, $28,319, and $29,840 for Whites, "Other Minorities," and Blacks, respectively,

Changers, Transfers, and Persisters all pegged their starting salary expectations at $28,200. First Timers had slightly higher expectations at $29,000 while, as expected, Leavers had the lowest starting salaries at $23,680.

What employment characteristics do students seek with regards to their long run career objectives? Of the thirteen listed characteristics, all but one (doing interesting work regardless of promotion opportunities) was rated as important to very important. Those aspects receiving the highest ratings included balancing my personal life with work (6.1 on a 7 point scale), make enough money to do other things (5.9), career with increasing promotions (5.4), freedom to make most decisions (5.4), and establishing a reputation in the field (5.4).

Factor analysis was used to determine a smaller set of common factors for comparison purposes. The following factors emerged:

Promotions:	Career path with increasing promotions, chance of becoming a partner or director of my organization, advance to a policy making position in my organization, and interesting work with opportunities for promotion (reverse scored to account for negative loading).
Job Freedom:	Free to make most of the decisions related to my work, free of close supervision in my work, and able to arrange my own work schedule.
Job Interest:	Establish a reputation in my field, do technical/research work I am interested in and develop new technology in my field.
Lifestyle:	Make more money than the average college graduate, balance my personal life with work, and make enough money to do other things.

Means for these factors can be found in Table X. Lifestyle attributes were the highest rated, followed by Job Interest and Job Freedom. Promotion's rating was low because of the low rating for interesting work with few opportunities for promotion. Clearly, everyone wanted an interesting job that had promotional opportunities.

Men and women did not vary noticeably although men tended to report higher ratings than women for the major job attributes with the exception of Lifestyle. Even though Lifestyle was important to both genders, women placed slightly more emphasis on these attributes in relation to men.

Blacks tended to place more importance on all the listed attributes, particularly with respect to Lifestyle and Job Freedom when compared to the other two groups. "Other Minorities" displayed an interesting preference with their lower scores on Lifestyle attributes. "Other Minorities" sought jobs where they could participate in interesting work and down played Lifestyle. While Lifestyle was important to "Other Minorities," they did not rate these attributes as high as the other two groups.

Leavers and Persisters were very similar in their ratings on Promotions and Job Freedom but diverged on Job Interest and Lifestyle. At the time of this survey, students enrolled in engineering appeared to have defined better employment objectives than those who switched to another major.

Table V. Importance of Selected Job Attributes to Career Objectives

	Overall	Gender		Race			Enrollment Status				
		Men	Women	White	Black	"Other"	First Timers	Changers	Transfers	Persisters	Leavers
Promotions	4.23	4.34	4.20	4.22	4.59	4.40	4.46	4.28	4.41	4.19	4.18
Job Freedom	5.07	5.11	5.02	5.00	5.59	5.22	5.10	5.23	5.26	5.01	4.98
Job Interest	5.22	5.30	5.14	5.16	5.61	5.42	5.46	5.39	5.33	5.33	4.89
Life Style	5.45	5.37	5.55	5.44	5.71	5.16	5.79	5.53	5.54	5.44	5.18

Conclusions

The primary thrust of this project was to determine the academic, social, and psychological differences between those who persisted in engineering and those who transferred to another major after enrolling in engineering. In addition, an attempt was made to identify problems that women and Blacks encountered while pursuing an academic program, as well as career, in engineering. The findings here provide a broad, sweeping picture of students' attitudes, perceptions, and performance in engineering.

Persistence. Leavers differed from Persisters on two key dimensions: academic performance and career goals. While both groups entered the engineering program from high school on equal footing, they quickly diverged, as freshman grade point averages indicate. It is easy to blame grades as the course for Leavers changing majors. However, the analyses suggest that Leavers initially had less commitment to engineering and inconclusive career goals. Grade problems accentuated the career goal discrepancies which triggered the move to a new academic major.

Mathematics was the basic culprit, undermining the students' progress in the program. In a comment section, respondents directed their frustration over mathematics in three directions: (1) on themselves -- they should have taken more courses in high school or studied harder; (2) on their high schools -- they didn't offer adequate courses; and (3) on the university -- specifically the rigor of the course versus similar mathematics courses that other majors take ("weeder" courses) and the foreign teaching assistants (not native speakers of English). A common remedy offered by many was taking mathematic prerequisites at a junior college and transferring the credits. The problem was not necessarily a loss of interest in engineering but rather the trials of taking mathematics.

Special attention needs to be given to Changers. Changers in many respects are very similar to Leavers, except they have not yet left the engineering program. In checking the enrollment status of Changers in this sample, it was discovered that five who had changed majors in engineering during the academic year in which this sample was drawn had actually dropped from engineering the term they received the questionnaire. Except for

no-preference majors who are moving into a core curriculum, advisors should monitor Changers more closely to provide with them the support they need to remain in engineering.

Women. Women who persist in engineering are really no different than men in terms of academic performance. Women, however, study more and are more concerned about their social life. For women, the basic problem was being taken seriously in the classroom, laboratory, and work place. We can talk about the lack of role models or a mechanical aptitude of women; but the real problem is their acceptance in a White male-dominated field. After a decade of increasing enrollments for women in engineering, their presence is real. It is unfortunate that so many feel ignored.

Blacks. Of all racial groups, Blacks have expressed the most personal frustration over their ability to succeed in completing the engineering program. Blacks work twice as many hours as Whites to finance their education; as a result, study time suffers. In comments, Blacks have shared their concern over poor academic performance, especially when compared to their high school academic achievements.

Several of the psychological measures that were used in this study must be brought into the analyses to better understand the attitudes and perceptions of all these students and especially Blacks. Further discussions with Black students should be pursued, not only to address the low response rate in this particular study, but to elaborate on conditions Blacks find at the University. It is clear, in many respects, that Whites have a different perception of Blacks than Blacks have of themselves with regards to their academic endeavors.

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